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ABSTRACT

This paper reports two studies which examined the relationship between problem solving strategies, response latencies, and efficient performance on measures of conceptual tempo. Study I demonstrated that teaching 8-year-old children to use efficient strategies on problem-solving tasks increased both the quality of their performance and their response latencies. In addition, it showed that the children returned to poor performance and short latencies when solving a new task to which they did not apply their strategy. Study II demonstrated that reflectives and impulsives both used short latencies and performed poorly when not using strategies, and that impulsives taught to use a strategy performed more efficiently and with longer latencies than untrained reflectives. It was concluded that response latency is a function of strategy, and that future studies should concentrate on differences in strategies of information processing between reflectives and impulsives, and not speed of responding per se. (Author/JMB)

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Effects of Strategy Training on Tempo of Responding

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Running head: Strategy and Tempo

Abstract

A number of studies have demonstrated that training impulsive children to use longer latencies does not necessarily reduce error rates on the Matching Familiar Figures test. By teaching children to use efficient strategies on problem-solving tasks, the first study reported here demonstrated that, relative to baseline performance, children increase both the quality of performance and response latencies when using an efficient strategy, but return to poor performance and short latencies when solving a new task to which they did not apply their strategy. A subsequent study also manipulated strategy use, and demonstrated that reflectives and impulsives both used short latencies and performed poorly when not using strategies, and that impulsives taught to use a strategy performed more efficiently and with longer latencies than untrained reflectives. It was concluded that response latency is a function of strategy, and that future studies should concentrate on differences in strategies of information processing between reflectives and impulsives, and not speed of responding per se.

Effects of Strategy Training on

Tempo of Responding

The papers in this symposium provide a diverse assessment of research involving conceptual tempo. First, the various problems associated with the Matching Familiar Figures test (MFF) itself, which have been nicely summarized by Ault and her colleagues (1976), may be offset to some degree by the norms provided here by Neil Salkind. However, as McKinney and I (1976) have argued elsewhere, a serious problem still remains that cannot be solved by norms; namely, the double-median split procedure which confounds the effects of latency and errors in nearly all published studies involving the MFF.

Second, there is the extremely important issue of how broadly the terms "reflective" and "impulsive" should be applied. In the paper to be read shortly, Moore will argue, on the basis of classroom observational data, for the importance of restricting the meaning of reflection/impulsivity to exclude naturally-occurring classroom behavior.

Third, as suggested by McKinney's paper, even the meaning of conceptual tempo for problem-solving performance seems to be in question. Our main argument is that the MFF has attracted such wide attention primarily because it claims to measure a cognitive trait; i.e., a generalized predisposition to respond slowly and accurately or quickly and poorly in situations of response uncertainty. There can be no doubt that Kagan intended the dimension of reflection/impulsivity to carry this rather heavy load. In one of the original articles on the MFF, Kagan (1965) stated:

The results [of his previous work with the MFF] are persuasive in

> in suggesting that a tendency for reflection increases with age, is stable over periods as long as 20 months, manifests pervasive generality across varied task situations, and is linked to some fundamental aspects of the child's personality organization (p. 134).

A year later, Kagan (1966) stated that reflection/impulsivity exerted its influence at two phases in the problem-solving sequence. Proposing a five-step problem-solving routine, Kagan argued that time to ponder was important during the selection of hypotheses and during the evaluation of these selected hypotheses. Kagan again left little doubt that it was time--the tendency to reflect--that distinguished impulsives and reflectives. He argued that his results "add validity to the postulation of a generalized behavioral tendency to be impulsive (or reflective) in problem situations where the child should consider the validity of his answers" (p. 24).

These claims of generality and the importance of tempo per se, however, came under serious question in the seminal paper by Block, Block, & Harrington (1974). Through working with personality measures in preschoolers, these authors held that the MFF predicted performance, not because of its measure of tempo, but primarily because of its measure of error rate. At about the same time, McKinney and I (Haskins & McKinney, 1976) provided evidence supporting this argument by using multiple regression and part correlations to demonstrate that MFF error scores were more closely associated with academic achievement and problem-solving performance than MFF latency. The force of these arguments is not to question the importance and meaning of cognitive tempo--of taking time to think, but simply to argue that the MFF itself predicts intellectual performance in some situations primarily because of its measurement of errors, and not because of its measurement of tempo.

Today, however, we would like to extend our examination of response tempo by considering the direction of influence between efficient performance and time. We argue that time, like age in developmental research, is in itself a meaningless variable. The object of psychology is to discover and explain the processes or operations that occur and change in time, but the existence of which is not even implied by the mere passing of time. Consider that MFF training studies attempting to alter response latency failed to substantially influence error rates; by contrast, studies attempting to alter children's scanning strategies changed both error rates and time (see McKinney, 1975; Messer, 1976). At least with regard to MFF performance, then, giving the child an efficient strategy changes both time and error rates, but increasing the child's latency does not effect error rate. The implication, of course, is that time is an artifact of strategy.

The two studies I discuss this morning were suggested by some work McKinney and I began about five years ago (Haskins & McKinney, Note 1). At that time, we were interested in improving children's problem-solving performance, and taught children to avoid noninformative responses on the Pattern Matching task explained previously. As you will recall, on this task children collect

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Slide 1

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information to eliminate patterns of eight binary dots by opening windows on a problem board containing the correct pattern. Children often open a window that provides no new information--does not allow them to turn over any new patterns. The object of the experiment was to train 8 year olds to avoid these noninformation moves, something that children do not do spontaneously untill age 11 or 12. The main results are summarized in this slide.

Slide 2

As you can see in the bottom panel, children taught to use a rule for avoiding noninformative responses performed quite capably. They committed only an average of 2.2 noninformative responses across four problems; children without strategy training committed an average of 7.7 noninformative responses. As a consequence, as shown in the middle panel of this slide, the overall performance of these two groups as measured by bits was much higher for children who received strategy training.

These results showed us that 8 year olds can learn a rule that makes their performance indistinguishable from untrained 11 or 12 year olds. But of greater importance for our concern in this symposium, as shown in the top panel of this slide, the latencies of children using a rule were much greater than those of children not using a rule--15.9 as against 5.2 seconds. And keep in mind that we did not so much as mention latencies, time, or the importance of working carefully or slowly to our subjects.

The obvious generalization to be drawn from this experiment is that it takes time to think. This being the case, we speculated that, as with scanning on the MFF, latency was a function of strategy--that latency was an artifact of rule use. To explore this possibility further, we designed a second experiment that extended the previous experiment in two ways. First, on the grounds that if it takes time to think, it should take more time to think more, we attempted to teach two strategies of differing complexity. The less difficult strategy was the Noninformative Response strategy in which children examine dots on the remaining patterns to be sure they always open a shutter allowing them to turn over at least one pattern. The more difficult strategy was Focusing. As you will recall from McKinney's presentation, in this strategy children examine dots on remaining patterns and select a dot position that will eliminate

exactly one-half the remaining patterns. This strategy always results in a three-move solution, and yields an average of 1.00 bits of information.

A second extension of the previous work was the use of two generalization tasks, one more and one less similar to the Pattern Matching task on which children were trained. The similar task, called Blocks, consisted of eight blocks that fit loosely into a tray with eight compartments. As shown in this slide, the tray and the sides and back of the blocks were painted black. When

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Slide 3

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turned over, however, the faces of the blocks were painted either blue or red,

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Slide 4

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and comprised patterns similar to those in the Pattern Matching task. As shown in this slide, eight patterns of eight red and blue rectangles were

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Slide 5

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displayed on the same board used in the Pattern Matching task.

The object of the Blocks task was to discover which of the eight displayed patterns was concealed in the tray. Children proceeded by turning over blocks to expose their colored face and then eliminating any of the eight patterns that had an incorrectly colored block in that position.

As you can see in this slide, the second task consisted of 42 drawings

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Slide 6

(see Mosher & Hornsby, 1966) of familiar objects--vegetables, toys, tools,

animals. Children were told that the experimenter was thinking of one picture in the array, and that they should attempt to discover the correct picture by asking questions that could be answered "yes" or "no". Thus, as with both the Pattern Matching and Blocks tasks, children could ask questions referring to one picture (Is it the shoe?) constraint-seeking questions that referred to more than one picture (Can it be used for travel?), or focus questions (Is it in this half of the board?). But the Pictures task differed from the other two tasks in the physical appearance and number of stimulus items.

Forty-five 8 year olds were randomly assigned to one of three groups: 15 to the Focus Rule group, 15 to the Noninformative Rule group, and 15 to the Control group. As demonstrated in this slide, children in all groups solved

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Slide 7

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two baseline problems without instruction. Following the baseline problems, children in the two rule groups received a demonstration problem during which the experimenter modeled a solution while describing how he could use the appropriate rule by studying dots on the remaining patterns. On the next problem, children in the two rule conditions received corrective feedback in which the experimenter corrected any deviations from the appropriate rule. Children in the Control group solved two additional problems instead of receiving instruction or corrective feedback. Children in all groups then solved two more Pattern Matching problems under conditions similar to baseline. Following these two problems, children in all groups were given two Blocks and two Pictures problems. In both cases, after familiarizing children with the task, the experimenter said: "Try to do it just like you did in the last game."

If latency is an artifact of rule use as we have suggested, then the results

should turn out as depicted in this slide. First, though all groups should perform in similar and inefficient fashion during baseline, both rule groups should exhibit significant increases in performance efficiency following training. These increases should hold for both the Pattern Matching and Blocks tasks. Second, since we are predicting that latency follows rule use, the latency of both the Focus Rule and Noninformative Rule groups should increase. By contrast, both performance efficiency and latency for the Control group should remain low throughout. Second, since the Focus Rule is more difficult than the Noninformative Rule, and requires more thorough examination of the remaining patterns before each move, children in the Focus Rule group should use longer latencies than children in the Noninformative Rule group. Third, on the basis of pilot work, we had reason to believe that children would not generalize their rule use to the Pictures task; indeed, this is precisely the reason we selected the task. If latency does follow strategy use, and if children in the rule groups do not use their rule on the Pictures task, our third prediction was that latencies for the three groups would once again be similar.

The results are summarized in this figure. Note first in the lower panel

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Slide 8

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that performance of all groups was similar during baseline. Following instruction, however, the two groups receiving rule training improved their performance significantly, and then maintained their gains on the Blocks generalization task. Thus, the manipulation of teaching rules of differing complexity was successful. Now examine the latency data in the upper panel. First, note that when performing randomly during baseline, all groups used short and nearly ident-

ical latencies. However, while concentrating on the stimulus array in order to employ their rule, the two rule groups significantly increased their latencies, but the Control group, still performing randomly, continued to respond quickly. Second, note the much longer latencies during the test phase on Pattern Matching and the generalization phase on Blocks by Focus Rule, as compared with Noninformative Rule, children. Third, notice that when confronted with the second generalization task, performance in the two rule groups declined and was not significantly different than the Control group. One might speculate that the reasons for this decline on the Pictures task were the greater number of stimuli and the lack of an obvious physical way to group the items. In any case, when performance declined, so did latency.

The results of this experiment, then, confirm our primary prediction that latency is a function of strategy. It now remains to link this conclusion with the MFF literature by demonstrating that it will account for changes in problem-solving performance by impulsive and reflective children. Specifically, we want now to predict that reflective children performing without a rule will exhibit latencies similar to those of impulsive children performing without a rule, and that impulsive children taught a rule will perform better and with longer latencies than either impulsive children taught to use longer latencies or reflective children performing without a rule.

Thus, we designed an experiment that included three groups of impulsive children, and one group of reflective children. Each of the four groups had nine, 8-year-old children. Of the impulsive groups, one was taught the Focus Rule discussed previously, and one was forced to delay 10 seconds before each response on two Pattern Matching problems. The experimenter told children in the Delay Training group that they would be able to solve these problems better

if they went slowly and thought carefully. To help them go slowly, we were going to time them before each response. They could open a shutter when the experimenter said time was up. If they wanted more time, they could take it, but they could not open a shutter until the experimenter said it was okay.

The procedures were similar to those of the previous experiment. Thus, children in all 4 groups solved two baseline problems with the Pattern Matching task. Then children in the Strategy Training and Delay Training groups solved two problems under training conditions while children in the two Control groups solved two more problems under baseline conditions. Following training, children in each group solved two more Pattern Matching problems. Finally, the two generalization problems with the Blocks task and the two generalization problems with the Pictures task were administered.

If our conclusions from the previous experiment were correct, then the following results could be predicted. First, children in all groups should perform randomly and with short latencies during the baseline problems. Notice that we predict no latency differences between reflectives and impulsives when children are performing randomly. Second, following training, the two Control groups and the Delayed Training group should perform randomly and with short latencies. Thus, children who were forced to use long latencies on the training problem should return to their use of short latencies since their training did not give them a rule that would improve performance and thereby increase latency. By contrast, impulsives trained to use a Focus rule should continue their efficient performance and their longer latencies on both the Pattern Matching and Blocks tasks. Third, since we know from the previous experiment that rule use does not generalize to the Pictures task, all groups, including the Strategy Training group, should again perform randomly and with short latencies on the

Pictures task.

The results, as shown in this slide, again confirm each of our predictions.

Slide 9

First, all children, including reflectives, performed at random during baseline and consequently had nearly identical and short latencies. Second, impulsives who were trained to use long latencies on the two training problems immediately returned to short latencies when the enforced delay condition was removed. By contrast, impulsive children who learned the Focus Rule used very long latencies, despite the fact that their training involved not the slightest mention of taking more time or proceeding cautiously. Note also that impulsive children using a rule performed better and with much longer latencies than reflectives performing without a rule. Third, impulsive children who performed well and with long latencies on the Pattern Matching and Blocks task, once again used short latencies on the Pictures task to which they did not generalize their rule.

Taken together, these studies provide experimental evidence that tempo of responding in situations of response uncertainty is a function of strategy use. Children performing randomly used short latencies; children performing in compliance with a rule used long latencies. When they returned to random performance, their latencies again declined. Thus, the manipulation of strategy use changed both the quality of performance and the tempo of responding. Further, the final experiment demonstrated that impulsives taught a rule adopted much longer latencies than reflectives performing without a rule. Moreover, while impulsives using a rule improved their performance and increased their latencies, impulsives taught to use longer latencies did not perform more efficiently and returned to use of short latencies as soon as permitted to do so.

When the results of these studies are set beside the results, just reported by McKinney, it seems apparent that impulsive children perform more poorly than reflectives primarily because they use developmentally less competent strategies on the type of tasks employed in these experiments. The real issue, then, is the method of solving the problem, and not the tempo of responding. It is folly to expect that slowing down impulsives will improve their performance on these or school-related tasks. Thus, our view is that subsequent studies of problem solving should focus on the differences in problem-solving strategies between reflectives and impulsives and not on their speed of responding.

Reference Notes

1. Haskins, R.T., & McKinney, D.J. Effects of corrective feedback and memory support on problem-solving strategies of eight-year-olds. Paper presented at the annual meeting of the Southeastern Society for Research in Child Development, Chapel Hill, N.C., March 1974.

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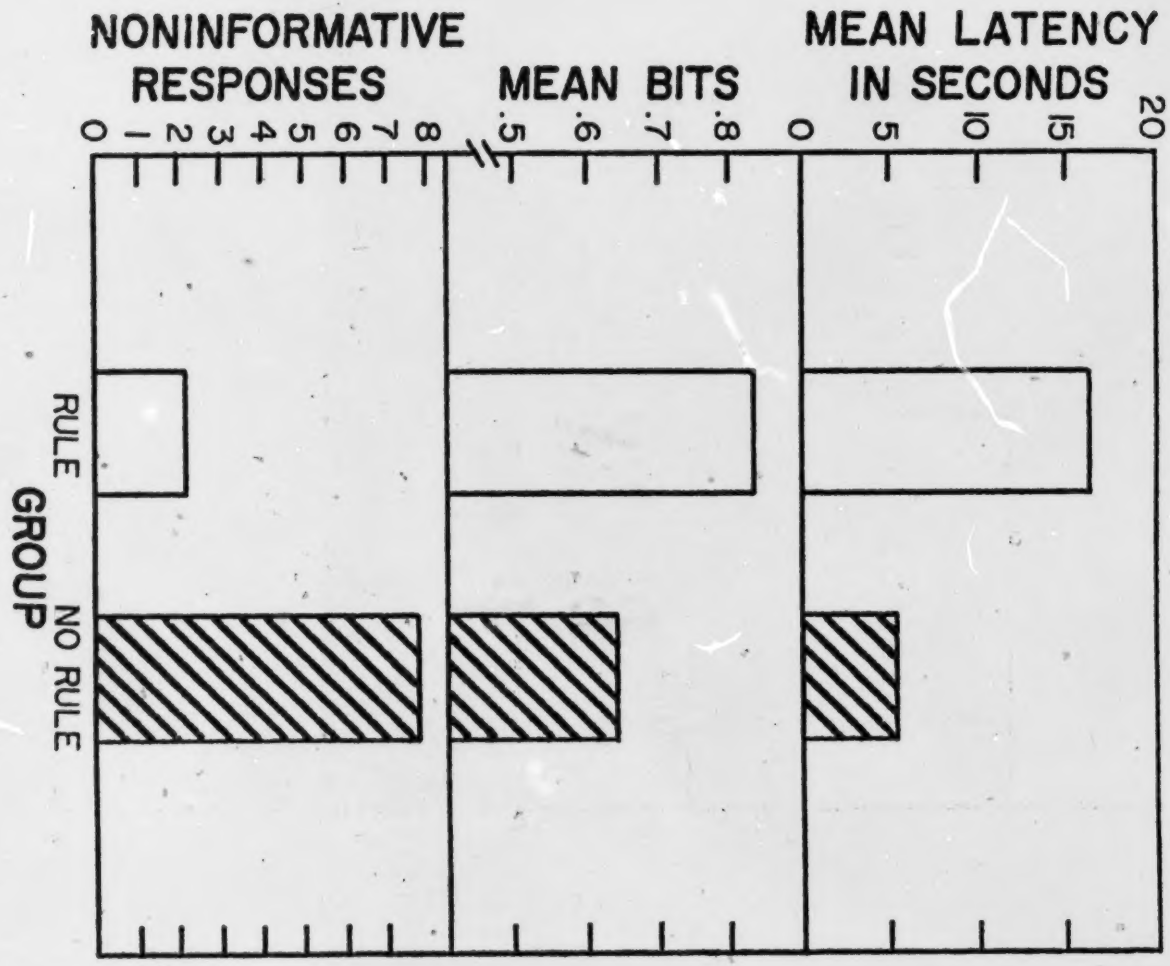
Slides

Slides 1, 3, 4, 5, and 6 are pictures of task materials and have not been drafted in a form suitable for reprinting. However, we would be happy to send details of any of these tasks to interested investigators.


NONINFORMATIVE RESPONSES
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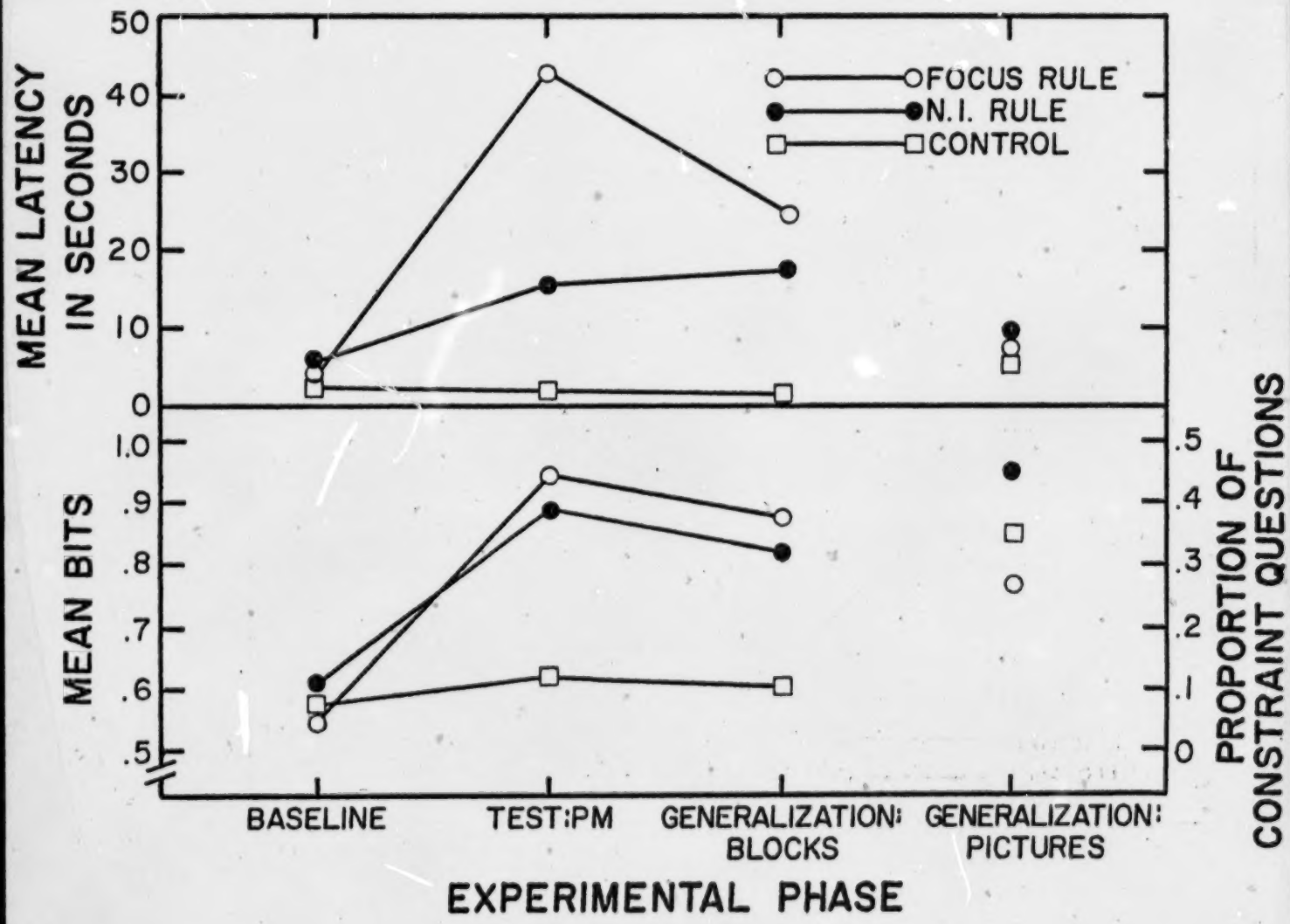
MEAN BITS
.5 .6 .7 .8
MEAN LATENCY IN SECONDS
0 5 10 15 20
GROUP
RULE
NO RULE

	BASELINE	TEST: PATTERN MATCHING	GENERALIZATION: BLOCKS	GENERALIZATION: PICTURES
LATENCY	All Groups Equal	Focus>N.I.>Control	Focus>N.I.>Control	All Groups Equal
EFFICIENCY	All Groups Equal	Focus>N.I.> Control	Focus>N.I> Control	All Groups Equal

Slide 7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20
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FOCUS RULE
N.I. RULE
CONTROL
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PROPORTION OF CONSTRAINT QUESTIONS
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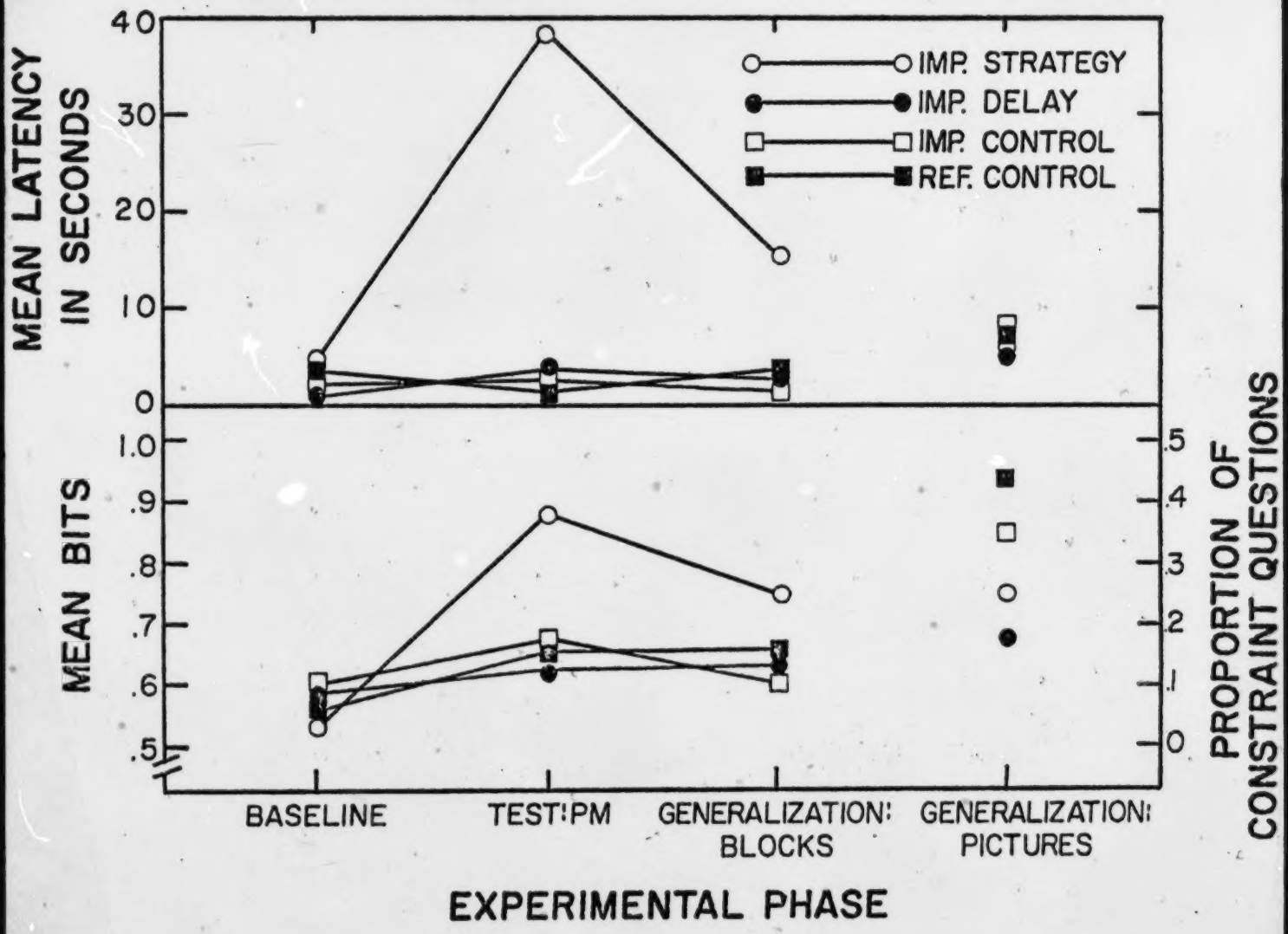
GENERALIZATION: PICTURES
EXPERIMENTAL PHASE

Slide 8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GENERALIZATION: BLOCKS
GENERALIZATION: PICTURES
EXPERIMENTAL PHASE

Slide 9